Providence Central Control

Montreal Urban Community Transit Commission

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2111, Berri Street
Montreal 132, Quebec

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the Public Relations Department
MUCTC
Suite 1011, 159 Craig Street West, Montreal 126.

General description

Providence Centre, so called because the land on which it is built was formerly the site of an institution of the Sisters of Providence, is situated directly on Berri Street between Sherbrooke and Ontario streets; it is bounded to the east by a lane, la ruelle de la Providence.

The concrete, blue brickwork and glass building is entirely new, constructed specifically to house Métro's "brain"; it has four floors and measures 220 feet by 40 feet.

The first floor, whose entrance is level with Ontario Street, apart from its garage and storage space, houses the telecommunications section workshops.

On the second floor are located two interconnected substations, Providence North and Providence South, 36,000 KVA each, individually energized at high tension by Hydro-Québec.

The third floor, entered from the north at street level, contains the Big Hall described in this booklet, in detail. Here are housed:

a — The Information Centre

b — The PCM (Power Control and Measurement)

c — The PCC (Central Control)

d — The Communications Centre

e — The Radio Guidance System (buses).

The fourth floor houses the Transportation Department Training Centre and the Métro Division offices.

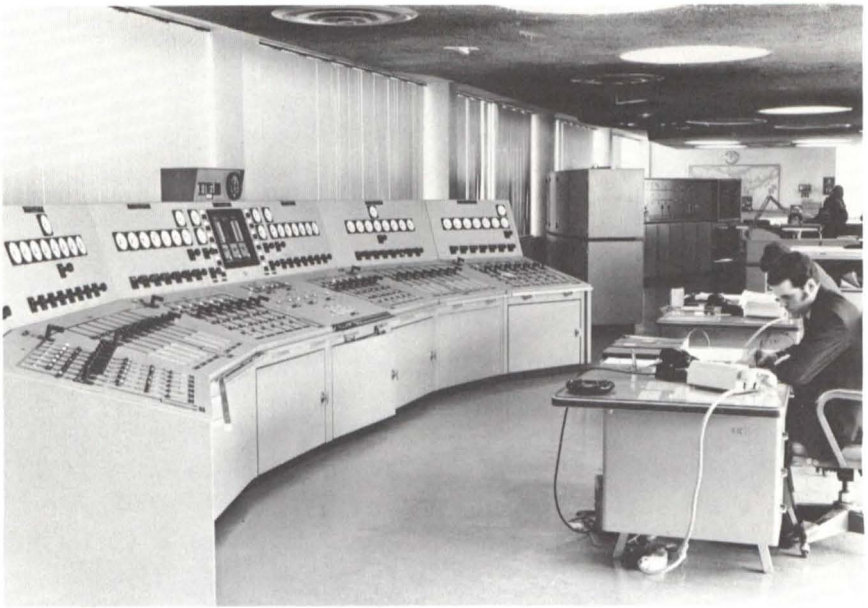
Informing the public

The main task of the Information Centre is that of providing uninterrupted service to the travelling public. These persons are on the job around the clock, twenty-four hours a day. It is manned by twenty employees schooled to handle all questions the system's users may ask.

Inquiries are rotated automatically, each in turn, to those on duty, by a system that in many respects is unique.

Persons seeking information are advised precisely as to what route to take, their transfer privileges, the rules of the Commission, etc., also dealt with, are travellers' complaints. Those which cannot be settled immediately on the telephone are reported to the department concerned.

The Information Centre registers some 900,000 calls a year.



Power control console

Métro lives electrically

Underground railways everywhere must have electrical energy to run their rolling stock and escalators, and for such auxiliary services as lighting, ventilation and disposal of water seepage. Also electrically controlled are signalling and telecommunications.

The quality of the electrical installation is therefore of prime importance to the sure and efficient operation of the entire system.

This installation comprises three divisions:

1 — General distribution
2 — Traction power
3 — Auxiliary services

General distribution of electrical energy

The main distribution substation is situated close to the point of peak electrical load. This substation, known as Providence, contains the main switch gear, together with Métro's entire dispatching and control system.

The substation is connected to Hydro Québec by six power lines of 12,000 KVA each, which come from two separate sources. Here in reality are two substations, each entirely independent of the other. Each receives three lines and is equipped with two tie-breakers.

The traction current is transmitted to eighteen rectifier stations built along the route of Métro's three lines. There are fifty-six secondary distribution points for auxiliary services, at two per station.

Traction power

Traction power is the electrical energy transmitted to the vehicle motors. The energy received at the main substation is fed to the different rectifier stations, located at the ground level, halfway between the passenger stations. This method of locating the rectifier feed in points between stations, balances the load required for train acceleration and increases performance on high speed runs.

Power conversion from the output of the 12,000 volt, 3 phase cables to the 750 volt direct current system is accomplished by a transformer and rectifier unit combination. The latter component — the rectifier — is composed of silicon diodes. The Montreal Métro was probably the first underground railway to have its entire system fed exclusively by this recently developed, efficient and trouble free static rectifier. Control devices here for operation and indication are linked to the Providence control board by direct wire.

The 750 D.C. current is transmitted from the rectifier stations through the ventilation shafts, and is applied to the guide rails on which slide the positive pick-ups of the motors. The conventional steel rails carry the return current, and also form part of the signalling circuit.

The driving current of each line is applied in two or more zones, normally connected by section contacts which open at each end of any defective zone.

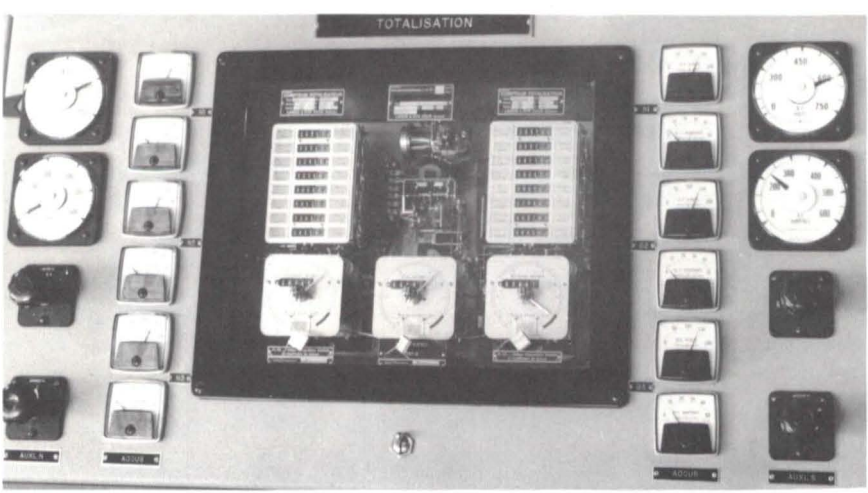
Auxiliary services

Two, three phase lead-clad cables set into the tunnel walls supply 12 KV current to each station's two secondary distribution points, where it is transformed down to 347/600 volts, three phase, for distribution to the auxiliary services, and down to 120 volts, monophase, for current outlets.

On a yearly basis, the largest consumers of electrical energy, within this auxiliary services group, in the order of size, would be lighting, ventilation and escalators. There are 126 escalators and 2 moving sidewalks in 21 of the present 26 passenger stations. Lighting intensity in stations is upward of 25 foot-candles. Emergency lighting is available from nickel-cadmium batteries.

Thirty-one ventilators, installed near the middle of each interstation, ordinarily combined with rectifier positions, blow air into the 15 miles of tunnels and stations. Adjustable for high or low speed, these ventilators have both on-the-spot and remote control.

The tunnels have fourteen pumping stations. Floats govern the pumps automatically, and proper functioning is under constant surveillance both from the changer's booth in each passenger station and from the control board at the Providence Control Centre.



The meters

Métro's nerve centre

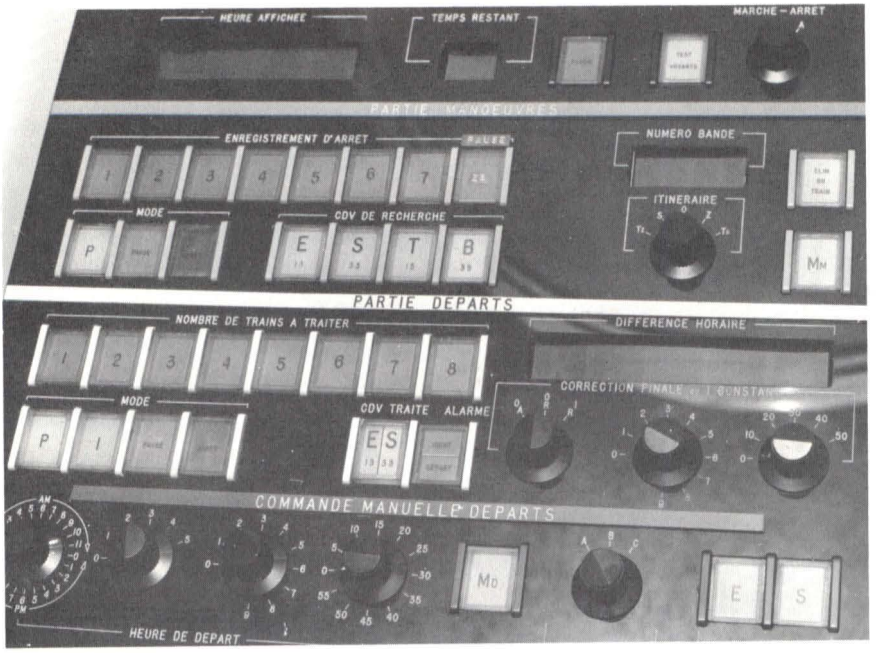
The purpose of Central Control at Providence Centre is that of enabling each line's Regulator, the officer chiefly responsible for keeping Métro running properly, to have the means of information, control and decision at his fingertips.

These means are brought together at Central Control (P.C.C. for **Poste de Commande Centralisée**), which among other things is equipped with an Optical Control Panel (T.C.O. for **Tableau de Contrôle Optique**). This Optical Control Panel shows where an operating train is located, at each and every moment, thanks to a device for identifying trains by number. There is also, electronic programmation to relieve the Regulator of all routine duties and keep him free to devote his whole attention and qualities of judgment to the handling of operational incidents. Programmation attends to his work as regards to departures and regularly scheduled operations each day at the terminal points. He also has the telecommunication system to transmit his orders and check upon their execution.

Teletransmissions

The desk is equipped with a microphone linked to the loud-speaker system of all metro stations. The Regulator, through his switchboard, is able to address agents or passengers of one station, of a whole line or the entire system. The desk is also connected to the Centrex (four digits) telephone system of the MUCTC (389 lines, 571 sets) and to the private three digit system of the

Point of central control



Manual programming machine

metro: 950 telephone sets, one at every 400 feet in the tunnel, one at each end of the station platforms, and one in every emergency compartment located on the platforms, the "red phone" connected in priority to Central Control.

Orders carried by teletransmission break down into two classes: remote supervision and remote control. In either case, the essential and special characteristic is that of security. In the railroad meaning of the term, this means that it is next-to-impossible to expedite incorrect information.

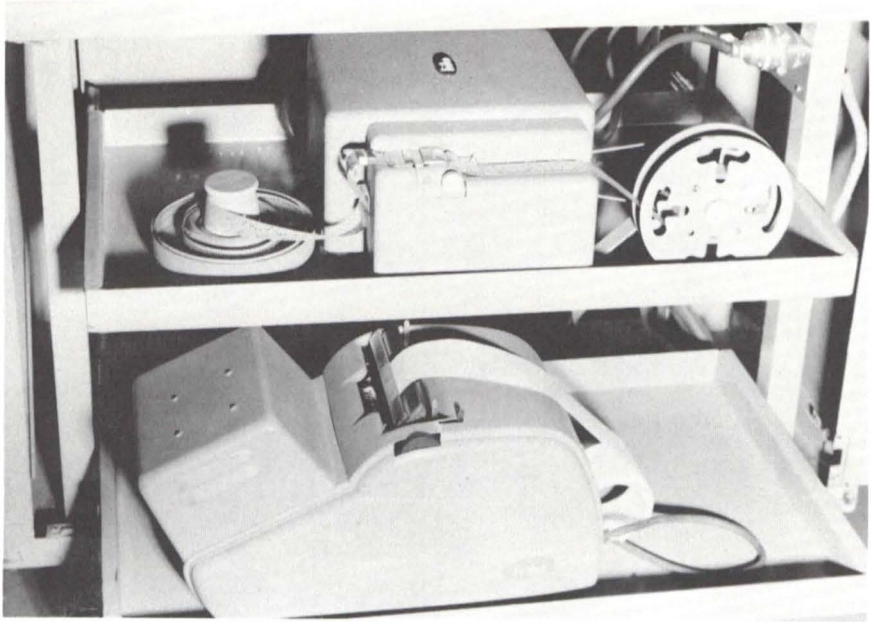
Information for transmission is collected in each passenger station and sent to Central Control. No information is exchanged otherwise than between Central Control and each station. Information is classified under twenty-five different headings. Some, dealing with signalling, are concerned with track circuit occupation or the control of crossover signals. Others have to do with rail switch positions or traction power equipment, still others are related to remote control, supervision of auxiliaries, the stations P.A. system, motor-pump alarms, etc.

Mainly for economical reasons, the telecommunication equipment uses two different methods, which may be summarized here by saying that Central Control is connected by wire to the nearer stations but electronically to those farther away.

Central control

The P.C.C. is the "brain" of the operation; it is the regulating centre. Each line is treated separately, coming under a Regulator who has his own Optical Control Panel, his own alarm panel, and two programme machines (one for each terminus).

The Regulator sits before a control board. Telephone calls converge here, besides which it has a number of control knobs. Set into either side of the board are control desks showing the programmation. The board is situated approximately in the centre of the oval formed by the Optical Control Panel.



Perforated tape programming machine

Optical control

The T.C.O. is the Regulator's chief working instrument. It gives him a succinct view of the line, its circuits and track equipment. The panel has a certain number of manual controls for such matters as simple itineraries. Other controls are multiple; for instance, the "Departure on signal" controls. Thus for each station there is direct control of the signal lights and of break or remake of the driving current. In addition to the aspect of signalling, the lower part of the control board shows whether the tracks are energized or not.

The Optical Control Panel has a very interesting innovation. It is especially useful in underground traffic with trains running at short intervals. At each and every moment, the Regulator can check a given train's position. The train has a two-digit number, which appears in an Optical Control Panel window. This number is situated at a point corresponding to the train's position; it follows the movement of the train in the tunnel by moving from window to window.

As a train leaves its storage area, the conductor operates a switch to record its identifying number. He receives a visual check to show that Central Control has registered the number.

All equipment in the Optical Control Panel follows the standard cards used functionally in printed circuitary. Complex as the assembly is, having more than 20,000 transistors, it is of very high precision.

Programmation

Automation is completed by the use of the electronic programmers which relieve the Regulator of routine tasks concerning overall operation, departures and movements at terminal stations. Each terminus has its own electronic programmer. It processes in terms of time intervals. It is able to make decisions and do very simple calculations at relatively low speeds with very great precision.

A perforated tape carries two types of information. One concerns the train's daily schedule and related data. Included are the numeral, the identification of the train entering the terminus, the nature of the operation and the point and hour of departure. Besides this control information, there is the other type concerning the number of trains present on the track circuits, the time by master chronometer which is to clock certain departure controls, and confirmation that itineraries transmitted by Central Control have been executed.

Using these two types of information, the electronic programmer:

— governs itinerary of movement or departure

— shuts off the train numbering device

— lights the destination indicator

— lights the departure board

— activates the entry indicators

— sounds the departure and gate-closing warnings

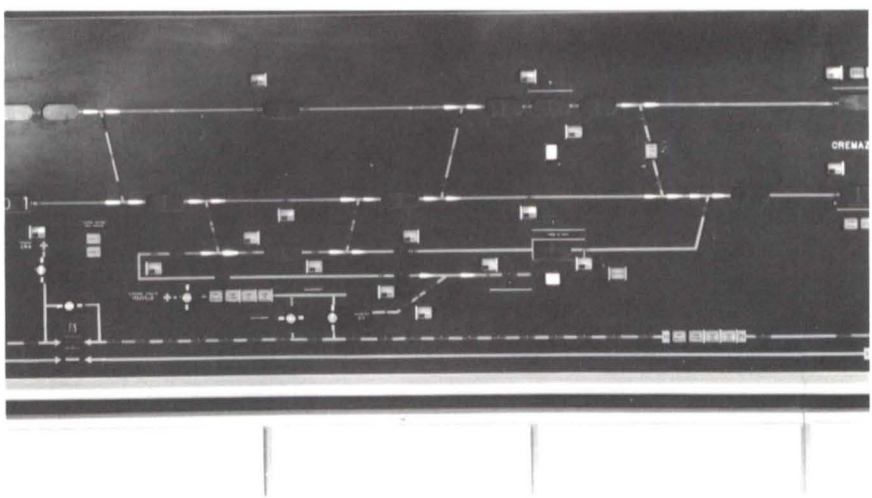
— orders the departure

— drops train numbers on withdrawal to storage area.

Various correctives are available to meet operational changes. Thus there is an effort-saving method whereby the Regulator can alter the timing as perforated (scheduled). He may, for instance, need to change a certain programmed hour, and this requires adjustment of other timing to keep the trains running at proportional intervals. This is done by setting out new departure times, all done by the electronic brain. There may also be a need for equalizing train intervals without regard to some target hour. Here the electronic programmer recalculates departure times in series, based in each case on the corrected hour of the preceding train.

Conclusion

The maximum centralization of information, means of supervision and control, provides methods of making changes efficiently without disturbing traffic, besides allowing great operational facility and flexibility.



Close-up of section of the T.C.O.

All-round preparedness

The Communications Centre of the Transportation Department (underground and surface systems) is organized in divisions, with supervisors and inspectors. It has tow trucks and other emergency equipment. Seven telephone lines are continuously available. There is a direct line to the Montreal Roads Department and another to the Montreal Police Department. The Centre is also connected to the Fire Department alarm system.

A red telephone in the Centre is tied in to emergency phones on Métro station platforms. A microphone at the Communications Centre control desk allows the operator to address travellers and Métro people in a given station, on a given line, or throughout the underground system.

Communications of the MUCTC also include an internal system of 350 telephone stations which, by a Centrex arrangement and with the help of 34 connections to the Bell Telephone Company's offices, rounds out communications with the outside.

Communications centre

Riding with the driver

An experiment using radio telephones to help drivers in surface traffic, is being tested presently by the MUCTC. The telephones have been installed in a certain number of MUCTC buses with the object of enabling drivers to regularize service even in emergencies, thus giving passengers better service.

A hundred vehicles on three lines have been equipped. The Centre can communicate:

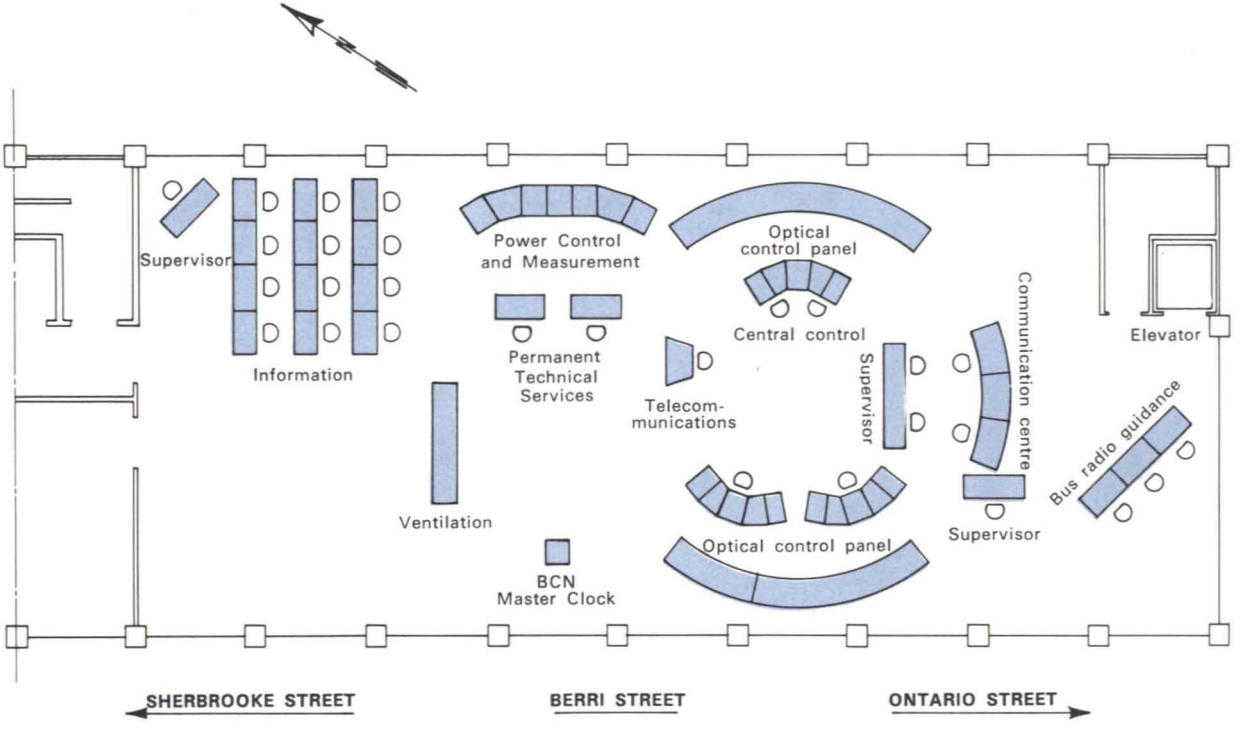
1 — with all drivers

2 — with drivers throughout a given run

3 — with an individual driver.

The apparatus is set to function at the turn of a contact key. The driver is to call the Centre in case of accidents, timetable delays, impaired traffic lights, fires, incidents requiring police intervention, traffic interruptions, etc.

Third floor plan



Montreal, September 1972.